Outreach and Partnering

With outstanding scientific and technical capabilities and an important national security mission, Lawrence Livermore National Laboratory is a national resource. The Laboratory's continuing success in understanding emerging national needs and technical opportunities depends on engaging sponsors and actively participating in the broad scientific community. Success in the Laboratory's research programs depends on strong ties to research universities and partnerships with U.S. industry.

The Laboratory's closest academic ties are with the campuses of the University of California (UC). In addition to more than 500 ongoing collaborations between Laboratory scientists and UC colleagues, joint research programs foster interdisciplinary collaborations. These academic partnerships strengthen research programs at Livermore and the campuses. University ties also serve as a valuable pipeline for recruiting new talent to the Laboratory. Partnerships with U.S. industry bring valuable research tools to Livermore programs—from the world's fastest computers to the world's largest laser. Industrial partnerships also lead to the transfer of the Laboratory's technological advances to the marketplace.

Lawrence Livermore is an important regional resource, too, contributing to the intellectual vitality of the San Francisco Bay Area and the San Joaquin Valley. Being a good neighbor is important to the Laboratory and its employees. As an institution, the Laboratory provides Californians with information and expertise on a variety of issues ranging from homeland security to groundwater management. Livermore partners in an array of educational, business development, and diversity outreach programs. The Laboratory supports a wealth of K–12 and community college science education programs and works with local universities and colleges. The Laboratory's 8,000-plus staff members and their families also contribute individually to the well-being of neighboring communities through charitable contributions and volunteer work.

The World Year of Physics at Livermore

The Laboratory celebrated the World Year of Physics with Science Week in May and special events throughout the year to mark the 100th anniversary of Einstein's four seminal, revolutionary papers. The legacy of this miraculous year lives on at Livermore, with the Laboratory at the forefront in many related research areas—from relativistic astrophysics to fusion energy research ($E = Mc^2$).

Research ties to Einstein's breakthroughs were featured on Science Day to open Science Week. Laboratory employees and honored guests from DOE, NNSA, and UC filled the auditorium to hear presentations by notable visiting and Livermore scientists. Many World Year of Physics activities were aimed at science education for neighboring communities, while other events were available for staff members.

Science Week included Community Leader Day, an opportunity for neighboring guests to tour research facilities, converse with Laboratory managers and staff, and join in the World Year of Physics celebrations. The more than 180 visitors were welcomed by Jerry Paul, principal deputy administrator for NNSA; Admiral Robert Foley, UC vice president for Laboratory Management; and Laboratory senior managers. A poster session and Laboratory tour included opportunities to learn about projects in homeland security and bioscience and to visit the Terascale Simulation Facility, the National Ignition Facility, and the Center for Accelerator Mass Spectrometry. The day gave guests a broad view of the Laboratory and its programs and plans and gave Laboratory leaders an opportunity to hear about important community issues.

To celebrate the World Year of Physics, (clockwise from top) Community Leader Day brought local mayors and others to the Laboratory, "Einstein" chatted with a Laboratory manager, and "Einstein" helped judge the egg drop contest for school children. A Web site kept the public and employees informed of events.

Expanding Efforts in Science Education

The Laboratory's science education programs and activities reached about 12,700 students in 2005, 20 percent more than in 2004. The programs are many and diverse: the Science on Saturday lecture series, the Expanding Your Horizons in Math & Science career conferences for young women, the School Tour Program for fourth and fifth graders, the Fun with Science traveling science show, Engineers Day, the Tri-Valley Science & Engineering Fair, and Got Science? Discover Science Saturday for students and parents.

Many programs featured the World Year of Physics theme. For example, the Laboratory, in partnership with the UC Office of the President, hosted Frontiers of Physics for 350 high school science students. The event featured speakers from the university and the Laboratory, a young scientists career panel, program displays, a tour of the National Ignition Facility, and an opportunity for students to talk with UC campus representatives. Also in 2005, the Laboratory and Livermore Valley Joint Unified School District signed a memorandum of understanding to work together to enhance science education in the district.

The Laboratory's Edward Teller Education Center (ETEC) is home for a wide variety of professional development programs for K–12 and community college educators. Sponsored by the Laboratory, the UC Office of the President, UC Davis, and UC Merced, the center aims to improve the quality of science instruction and technology applications in the classroom. In February and March, ETEC and the Laboratory conducted special teacher development workshops in partnership with Alameda County Supervisor Scott Haggerty and Congressman George Miller (7th District, California). The sixth annual Edward Teller Science & Technology Education Symposium, a two-day event held in September, was attended by more than 200 California teachers. The participants received up-to-date science information in topical areas as well as lessons and activities for use in the classroom. Other activities at ETEC included computer technology workshops and a Teacher Research Academy in July in the areas of

During a Fun with Science presentation, ninth-graders from Oakland learned about atmospheric pressure (top). Students analyzed an unknown powder found at a mock crime scene during the annual Science Adventure Institute in Livermore (SAIL) (above).

Three local high school students were winners of the Edward Teller Science Scholars awards, which are scholarships given to graduating seniors who excel in science studies.

biotechnology, biophotonics, and environmental science.

In a review of these programs by the Secretary of Energy Advisory Board (SEAB) education outreach subcommittee, Livermore's programs were found to be of high quality and to exemplify many best practices for other government education programs.

A Good Neighbor

The success of the Laboratory's educational outreach programs depends on the more than 500 staff members each year who volunteer their time and serve as science lecturers, mentors, science fair judges, and presenters or instructors in workshops and classrooms. Livermore employees also engage in other outreach activities through participation in community assistance and economic development organizations. The Laboratory's *Community Report*, available from the Public Affairs Office and online, summarizes the many ways the institution and Livermore employees benefit neighboring communities.

The Laboratory's Help Others More Effectively (HOME) campaign raised about $1.5 million for Bay Area and San Joaquin Valley charitable organizations in 2005. Livermore employees marked their seventh straight year of contributions totaling more than $1 million. The Laboratory is the largest single workplace supporter of the Tri-Valley Community Fund, which is dedicated to raising and distributing local charitable contributions to human service, educational, cultural, and recreational organizations. As part of the HOME campaign, employees also raised over $75,000 for Hurricane Katrina relief.

Helping Ensure Clean, Reliable Water Supplies

Water management is one research area where Laboratory science and technology development programs apply directly to regional issues. Livermore is creating tools that will help water resource managers make the best decisions about California's water supply infrastructure, protection, and treatment.

As an example, the Laboratory is working with the State Water Resources Control Board in the Groundwater Ambient Monitoring Assessment (GAMA) project. Livermore is applying its state-of-the-art facilities for age

Holiday gifts for the less fortunate are one of the ways that Laboratory employees contribute generously to the community.

The Groundwater Ambient Monitoring Assessment project makes use of this State of California-certified environmental analysis facility at Livermore.

dating tritium (helium-3 presence) and methods for low-level detection of tracers and contaminants to detect migration. Integrated with high-resolution hydrologic models, these capabilities are aiding California in assessing groundwater vulnerability to MTBE, nitrates, and other contaminants. The work during the next five years will focus on 116 priority groundwater basins that account for 90 percent of the state's groundwater use. Laboratory scientists will analyze and interpret the results from samples taken from selected municipal water supply wells and provide the results to the State Water Resources Control Board and the U.S. Geological Survey.

Research Collaborations With University of California

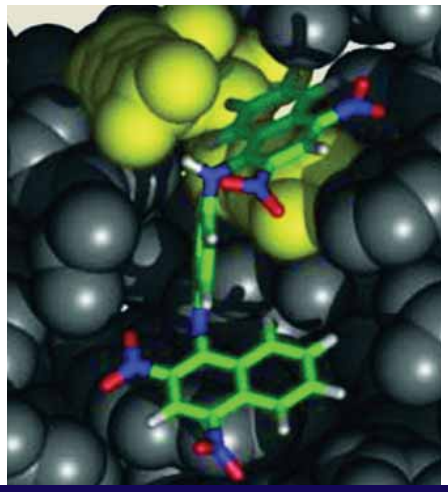
Collaborations between the Laboratory and UC campuses serve to strengthen research programs at Livermore and provide the campuses with access to Livermore's multidisciplinary capabilities and special research facilities. More than one-quarter of the roughly 1,000 peer-reviewed journal articles produced each year by Laboratory scientists are coauthored by colleagues at UC campuses. Larger-scale collaborations take place through partnerships in research institutes on campuses and at the Livermore site.

One of the Laboratory's many strong ties with UC Davis is the UC Davis Cancer Center, a National Cancer Institute-designated center. In 2005, the National Cancer Institute (NCI) renewed the designation for five years and provided $14 million in new federal funding through 2010. The UC Davis Cancer Center's program now comprises about 180 scientists at work on more than 300 cancer projects on three campuses, including the Laboratory. The center's partnership with Livermore, the first of its kind in the nation, was a key factor in first winning the NCI designation in 2002. In the partnership, physicians and scientists are turning technology developed for national security into new cancer therapies, detection methods, and prevention strategies.

An exciting area of collaboration is the design and application of SHALs (synthetic high-affinity ligands) to fight cancer. SHALs are tiny molecules specially designed to bind to unique sites on the surfaces of proteins. A Laboratory researcher conceived of SHALs to bind to potential bioterror agents like botulism or anthrax, quickly and efficiently detecting and neutralizing them. Now his team is designing SHALs that bind to "activated" receptors in cancer cells. With this tool, physicians can better assess the likelihood of rapid cancer growth and fight the disease.

Livermore and cancer center researchers are also using atomic force microscopy and computer simulations to provide a reliable new technique to characterize

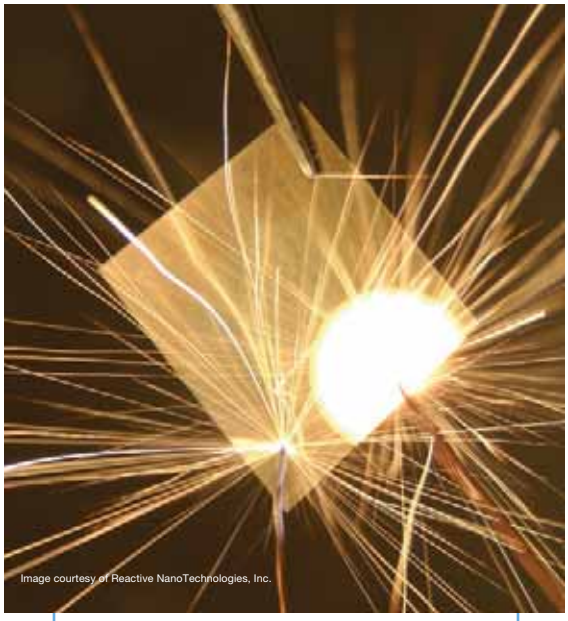
Lawrence Livermore is a research partner in the UC Davis Cancer Center, a National Cancer Institute-designated center.



In collaboration with the UC Davis Cancer Center, nanometer-size molecules are being designed that bind to lymphoma cell proteins and inhibit the rapid cell growth of cancer.

the binding interaction between peptides that are cancer markers and antibody fragments that mimic the architecture of a cancer drug. The aim is to improve targeted drug delivery in cancer treatment. Another collaboration applies Livermore's accelerator expertise to the development of a small, inexpensive proton accelerator system for radiation therapy that targets only tumors, sparing surrounding healthy tissue. Because proton radiotherapy systems today are the size of stadiums and cost more than $100 million, this new system could revolutionize radiation therapy.

The Laboratory is assisting in the establishment of UC Merced, the nation's first new public research university of the 21st century. The UC Merced campus opened in September 2005 and will eventually be home to 25,000 students and 6,600 faculty and staff. The university has a close affiliation with Livermore, and its research areas are being aligned with the Laboratory's in a number of areas. In one strategic collaboration, for example, Livermore staff are working with UC Merced faculty on regional environmental research.



An R&D 100 Award winner, NanoFoil® can "solder" components together with no thermal damage.

Laboratory Technology in the Marketplace

In 2005, Livermore scientists and engineers—and their research partners—earned four R&D 100 awards. Each year, *R&D Magazine* presents awards to the 100 top technological advances of significant potential benefit to society. Since 1978, Laboratory researchers have won 106 R&D 100 awards, and many of these inventions were developed in partnerships or have been transferred to U.S. industry for commercial development. In 2005, the award winners included two systems developed for homeland security, the bioaerosol mass spectrometry system (BAMS, see p. 20) and the adaptable radiation area monitor (ARAM, see p. 18). The VisIt visualization tool (see p. 25), used to process gigabytes of data in useful graphic forms, was also honored.

The fourth R&D 100 Award winner, NanoFoil®, was featured on the cover of the *Strategic Plan for the National Nanotechnology Initiative*, issued by the Executive Office of the President. NanoFoil is a revolutionary product to metallically bond a small component to another item—such as a computer chip to a heat sink—with no thermal damage. The foil consists of thousands of nanolayers of nickel and aluminum that chemically react when pulsed with energy. The reaction heats the surrounding solder material in a controlled manner. NanoFoil grew out of technology at the Laboratory to fabricate multilayer x-ray and extreme ultraviolet optics. It was developed in partnership with researchers at Johns Hopkins University and Reactive NanoTechnologies in Hunt Valley, Maryland, which manufactures and exclusively sells NanoFoil.

UltraCell Corporation of Livermore, California, has developed a portable fuel cell that could power a laptop computer for an entire day without recharging. UltraCell's new fuel cell has twice the energy density of standard lithium batteries and can provide continuous power at remote locations. Users can swap out the methanol fuel canisters for fresh fuel while the computer is in use. UltraCell has an exclusive licensing agreement to use Laboratory-developed micro-fuel-cell technologies, including a microreformer, a microelectromechanical system that converts methanol fuel to hydrogen. Through many other license agreements, numerous Laboratory-developed products are now in the marketplace, earning licensees revenues estimated at more than $300 million.